

*On the life-history of Arbela tetraonis, Moore, a destructive Insect pest in Casuarina Plantations in Madras.*—By E. P. STEBBING.

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How little is really known about our Insect foes in India is becoming increasingly evident day by day. An insect suddenly swarms over an area in numbers owing to some particularly favourable conditions in its surroundings, it commits serious depredations in the fields, orchards, or forests of the tract it is invading, and owing to its being so very much *en évidence* or owing to the great damage it is committing specimens are collected and sent for identification to specialists. The odds are greatly in favour of its being new to science. Instances of this state of affairs are numerous, and it may be said that leaving out of account the butterflies and one or two other groups which have received attention it is easier to pick up a new species in many parts of the country than to collect one that is known. The insect about whose life-history, as far as it is at present known, I wish here to put on record a few notes furnishes an illustration of the aptness of the above remarks, since although rare in Collections and new to those of the Indian Museum its larva has been known for some years as a destructive bark eater in Casuarina plantations on the eastern seaboard of Madras. There may, however, be said to be some excuse for its having remained so long undiscovered since it belongs to a family of moths, closely allied to the *Cossidæ*, which have been little studied and the life histories of whose members are little known, the larvæ living mostly in the wood of trees. The moths are rarely seen and owing to the habits of the larva are difficult to find. The pupal stage and pupa of the English Goat-moth is known, and has been described; but very little is known as to other pupæ of the family. The description of the pupal stage of this insect given below is therefore of some interest.

In the Indian Museum we have but 4 genera and 11 species of the family *Cossidæ* from the Indian Region, the insects being *Cossus cadambe*, *Duomitus ceramicus*, *D. strix*, *D. lenconotus*, *D. mineus*, *Azygophleps asylas* (said to be S. African by Hampson in the Fauna), *A. pusilla*, *Zeuzera indica*, *Z. pyrina*, *Z. multistrigata*, and *Z. Coffeæ*. There are also two unnamed specimens one of which is an *Arbela* and closely allied to the insect under description. This latter specimen was obtained by the late

Mr. De Nicéville and is labelled Calcutta 1891. It is the only representative of the *Arbelidæ* in the Museum Collections. The genus *Arbela* has a fairly wide range, inhabiting, according to Hampson, Peninsular India, Ceylon, and Burma.

The species here described appears to infest most of the Casuarina plantations on the Madras Eastern Seaboard. Hampson records it only from Poona, Bombay, and Raipur.

Hampson gives the description of the genus as follows: Palpi minute, antenna bipectinated to tips in male, the branches short, simple in female. Mid and hind tibiæ slightly hairy with terminal pairs of spurs. Forewing with veins 7, 8, 9 stalked together. Hindwing with cell of normal length; vein 6 given off below the angle; vein connected with the subcostal nervure by an oblique bar near centre of cell.

*Arbela tetraonis*, Moore, P.Z.S., 1879, p. 411, pl. 34, fig. 3; C. & S., No. 1605; Hampson. F. Br. Ind. Moths I. 315, No. 675, (♀).

♂ Head and thorax covered with long silky brown hairs. Abdomen with long greyish hairs. Forewing greyish, thickly irrorated with dull-brown spots which tend to form transverse bands; three large velvety-brown patches, one centrally, placed a little below the costa, a second near the base of the wing, and the third, the largest, a little beyond it.

Hindwing grey irrorated with a few ashy-coloured spots and a dark marginal band. Exp. 43 millim.

♀ Already described by Hampson.

*Larva*. Head black with a few longish yellowish-white hairs on it. Following three segments, which each bear a pair of long legs, yellowish, this colour merging into pink on the third. These three segments are swollen and larger than the head. The following segments are flesh-coloured except the last which is yellowish. Five pairs of short sucker legs are present, one pair each on the 6th to 9th and a pair on the last segment. A few long scattered whitish hairs on each of the segments. These nine segments are narrower than the first three [and taper off slightly behind so that the 12th segment has only about the diameter of the 4th. Length  $\frac{1}{2}$ ". Width of thoracic segments 3-16ths inch.

*Pupa*. Very shining, yellowish-brown merging into black at anterior end. Circular in section and of uniform thickness throughout except for a slight swelling at thoracic end, which is furnished at the top with two small spiny spikes; the last segment tapers bluntly. Wing covers short, shining yellowish-brown posteriorly merging into black above. Abdominal segments visible, 7 to 8 dorsally, 5 ventrally. The last 5 bear transverse circular rows of fine saw-like closely set black teeth upon them, the first three segments having a double row placed

slightly apart near the centre whilst the last two have but one encircling band situated near the centre. The last segment is blunt at its posterior extremity where it is furnished with a circle of irregularly sized black spines. The two segments visible dorsally immediately anterior to the first of those bearing the double encircling girdle of teeth have each a single row of closely set curved teeth placed near their anterior margins which end on either side at the wing covers. Long. 21 to 28 millim.

As we shall see later the presence of these spines is absolutely essential to the pupa since by their means it is able to make its way from the heart of the tree where the larva pupates to the outside in order to provide for the escape of the moth.

The appearance of the moth on the wing is evidently very variable. In the Godaveri district a report states that the insect issued as early as March. A specimen taken in 1901 and preserved for transmission to me got damaged and so was not sent, but I have little doubt from the descriptions given that the insect was the *Arbela*. In Ganjam on the other hand a specimen was bred from a pupa by Mr. C. E. C. Fischer, of the Imperial Forest Service, as late as the 3rd July of the present year. The specimen so bred is the only one that has been yet recorded from the Casuarina Plantations of Madras, and should the one in the Indian Museum taken by Mr. De Nicéville in 1891 prove a different species, it forms the only record of the species that I am aware of in India. When I state that I have seen probably several dozen empty pupal cases upon the trunks of the trees in one small plantation alone, it will be obvious that although in its particular locality so plentiful it is not often taken.

From Cuddalore nearly mature pupæ were sent to me on June 1st. It would thus appear that the moth is to be found on the wing between March and beginning of July. I could find none in a plantation at Chatrapur (Ganjam) between the 9th and 13th July, 1903, although I noted numbers of the empty pupal cases on the Casuarina trees.

Since the moths of this family are unprovided with a proboscis and consequently take no food at this stage of their lives they probably lay eggs soon after emerging. The eggs are deposited upon the bark of the trees. We do not yet know what period elapses before they hatch out. Ganjam being situated in the N.-E. corner of the Presidency gets the S.-W. Monsoon which bursts about the middle of July and consequently the eggs would probably not hatch out until September or October, after the worst of the rains are over. Further south, however, where this monsoon is not felt and the rain is not received until October and November they may hatch out earlier. The at present recorded months in which larvæ have been obtained are January and March in Chatrapur (with pupa

in June and a moth on 3rd July); December in North Arcot (with pupa in June); the same month in Godaveri (with pupa and moth in March); full-grown caterpillars and almost mature pupæ in Cuddalore on June 1st and what appear to be nearly mature larvæ in Nellore also in June.

We have yet to ascertain the period spent by the larvæ in this stage of its existence. In some instances in the case of allied families two to three years are passed in this stage. So little is known about the larvæ of this and the *Cossidae* that only the caterpillars of *Duomitus niger* (the 'black borer' of coffee planters) and *Zeuzera coffeæ* (the white borer of coffee planters), are described in the Fauna and no larvæ of the *Arbelidæ*. They are considered to spend nearly, if not over, a year in the larval stage. In the case under consideration I am of opinion that the larva spends less than a year in the grub stage, and the difference may be due to the fact that whilst the former two feed on wood the latter confines itself until full-grown to a bark diet. Whatever the period may be however which the larvæ passes in its grub stage the greater portion of it is spent upon the bark of the tree and not inside the wood.

I have said that the eggs are laid upon the bark, and they may be so deposited in patches, and if so the young larvæ may be gregarious for a time after hatching out. This is to some extent borne out by the fact that the thinner bark of the trees is seen to be eaten off in patches. If they are however gregarious at first this condition would not appear to last long since the greater part of the larval life is spent in a solitary state, and at this period the grub constructs for itself a covered-way gallery resembling a glorified termite gallery running up the outside of the bark. This covered way is formed of particles of its excreta bound together with a fine silk. Externally the appearance is simply that of a mass of excrementous particles. These covered ways curl round or run up or down the stem of the tree and are very conspicuous, being from one-third to one-half inch in breadth externally and from nine inches to as much as eighteen inches in length. They are reddish-brown to, in parts, black in colour and form raised galleries on the surface. Sometimes the gallery completely encircles the stem, the tree being then ringed; at others it is taken in a spiral manner up or down the tree. The covered ways have a more or less uniform width throughout their length and from their appearance the larva would seem to add to them at the sides so that the internal chamber remains uniform in width throughout its length. Generally only two to three of these galleries are to be found upon any one tree and then generally far apart, and it would therefore appear probable that if a considerable number of eggs are laid together in a patch there must be a high mortal-

ity amongst the young larvæ. The foliage of the *Casuarina* is very thin and open and a caterpillar feeding in the open on the bark would be very visible to bird and other depredators. It is, therefore, within the bounds of probability that the caterpillars suffer heavily in this manner in early life and that the grub has developed the habit of living in a protective tunnel to safeguard itself from these attacks. During the whole period it spends upon the trunk of the tree the larva feeds upon the bark eating this latter away either in thin irregular-shaped patches in places adjacent to its covered gallery or gnawing it right through down to the wood below under the shelter given it by the covered way itself. In this way the tree is at times very nearly girdled, and if a number of larvæ are working close together the result is probably the death of the tree. Some trees seemed to be more preferred than others, several moths resorting to them to oviposit. In such cases it often happens that one or more of the covered ways made by the larvæ developing from the eggs meet at a kind of junction and a large mass of excrement and silk forms a great bulge on the tree from which, if the moths have flown, several empty pupal cases may be seen protruding quite close to one another. When full fed the larvæ returns down its covered way until it has reached to about the centre and then bores horizontally into the tree, going deep to the centre of the heart wood. This tunnel is kept quite clean all the wood particles being ejected from it. When it has arrived there after making a tunnel which may be as long as six or more inches though in smaller trees it is considerably less, it slightly enlarges the chamber, turns round in it and pupates. This tunnel in the wood is only bored by the larva for pupating purposes. It does not ramify about in the wood as would be the case if the grub were feeding in the wood.

From the periods at which both larvæ pupæ and moths have been found it is probable that the time passed as a pupa is short, probably a month at most. When the moth is nearly ready to emerge the pupa projects itself along the tunnel by wriggling forward with the help of the rows of spines with which its outer covering is garnished. On reaching the end of the tunnel it forces its way through the covered way from the outer surface of which it projects for about one-fourth of its length. The case then splits down anteriorly and the moth crawls out. These empty pupal cases found projecting in this manner from the covered ways enable a period to be roughly fixed for the term of pupation. Under the action of the monsoon rain they soon get soaked and sodden and fall off the tree, and it is thus certain that but a few weeks are passed by the insect in this quiescent stage of its existence.

The points which still remain uncertain are the exact length of

time spent as a feeding larvæ, the number of eggs laid, and the time spent before they hatch out.

In addition to the scientific instinct which attaches to the taking of this insect and to the study of its life-history both, owing to the little known about the habits of the family, of some importance there is another aspect, the economic one, which is equally deserving of attention. The *Casuarina* has been planted, and is being planted, in Madras with two objects in view; the one, to protect the cultivated lands or towns and villages, roads, &c., from the encroachments of moving sand dunes, and secondly, to provide timber and fuel for the inhabitants in areas where the only other tree growth is palm trees. The action of the larvæ of this moth by which trees are often killed off and plantations or portion of them ruined is therefore of some importance.

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